A Case Study: Implementation Lean Tools in S.S. Pipe Manufacturing Industries.

Geeta M. Amin1, Dr. Mohit .B. Diwan2.

1 Pg student ,Mechanical Engineering Department ,TITS Modasa ,Gujarat, India

2 .HOD, Mechanical Engineering Department

Shankersinh Vaghela Bapu Institute of Technology, Gandhinagar, Gujarat, India

ABSTRACT

The purpose of this study is to discuss the lean implementation process and its quantified benefits with the help of value stream mapping (VSM) and 5'S lean tools.

Both current and future state map's of the organization's shop floor are discussed using VSM techniques in order to highlight improvement areas and to bridge the gap between the existing state and the proposed state of shop floor of the selected industries.

Key Word :*5's, VSM, Takt time, Up time, Cycle time,.reduction in time , waste elimination etc.*

1) INTRODUCTION

Lean manufacturing is one of the initiative that many major businesses in the word have been trying to adopt in order to remain competitive in an increasingly global market. Lean manufacturing has been the buzzword in the area of manufacturing for past few years in world. To understand what lean is it is helpful to understand why it developed lean (and the Toyota production system) have two main purpose; provide customer satisfaction and do so profitably. Principal of lean manufacturing are widely used by industries to eliminate waste. A lean organization understands customer value and focuses its key processes to continuously increases it. The ultimate goal is to provided perfect value to the customer through a perfect value creation process that has zero waste.

2) VALUE STREAM MAPPING

The use of value stream mapping (vsm) has been attributed to the cause of much of the success that Toyota of japan has had since the 1980'sl. Developed during the work conducted by Taiichiohno at Toyota in the 1960,s and 70's, at its basic level VSM is a systematic methodology to identify wasted time and action in a re-engineer businesses because it identified unnecessary effort and resources to permit simplification of operational processes.

3) THE 5S :

- Seiri-sort: (elimination that which is not needed)
- Seiton- set in order (organization remaining items)
- Season- shine (clean and inspect work area)
- Seiketsu-standardize (write standards for above)

5'S helps to eliminate waste that results from a poorly organized work area.

FIG 1 : THE 5S

4) MAIN REVIEW WORK ON LEAN MANUFACTURINMG:

Adam brown et al 1) : The sustainable value stream mapping (sus-vsm) in different manufacturing system configurations achieving sustainability in manufacturing requires a holistic view spanning product design. Manufacturing processes. Manufacturing system and the entire supply chain. Such an approach must be taken to ensure the economic. Environment and societal goals of sustainability are achieved. Value stream mapping (VSM) is an important technique used in lean manufacturing to identify and visualize waste.The ability of visually assess manufacturing sustainability through VSM increase its usefulness as a tool to identify potential areas of improvement.

A.deif et el 2) : The assessment lean system using variability mapping a new approach to assess lean manufacturing based on system's variability is proposed. The assessment utilizes a new tool called variability sources mapping (VSMII) which focuses on capturing and reducing variability across the production system. The new tool offers a new metric called variability index to measure the overall variability level of the System. Based on the mapping and the metrics.

Benjamin haefner et el 3) : The quality value stream mapping companies in the manufacturing industries today are faced with increasing challenges with respect to cost effectiveness, lead time and quality of the production system. Dealing with these contradictory goals, an important task is the selection of the production system. Dealing with these contradictory goals, an important task is the selection of suitable solution for the integration of inspection processes within the process chain, which are necessary to ensure the required production quality. For this, supportive and easily applicable planning techniques are required to analyze and design the configuration of a respective process chain.

Bhimsingh et el 4) : The lean implementation and its benefits to production industry with help of value stream mapping (VSM). Both current and future state maps of the organization's shop floor scenarios are discussed using VSM techniques in order to highlight improvement areas and to bridge the gap between the existing state and the proposed state of floor the selected industry.

Danijelagracanin et el 5) : The using cost-time profit for value stream optimization is very is very important for lean manufacturing efforts. This paper introduces the framework for value stream optimization by combining value stream costing and cost-time profile.value stream mapping represented very efficient tool for visualization of activities within production flow focused on activity duration with the purpose to eliminate non-value activities.

Fawaz a. a bdulmalek et el 6) : The analysing the benefits of lean manufacturing and value stream mapping via simulation the "lean " approach has been applied more frequently in discrete manufacturing than in the continuous / process sector. Mainly because of several perceived barriers in the latter environment that have caused manager to be reluctant to make the required commitment. Value stream mapping was the main tool used to identify the opportunities for various lean techniques.

5) METHOD OF DATA COLLECTING :

Research will observe all the activities that perfected in the production shop floor. The research will go through the production shop floor and identified each operation process involved from raw material to finished goods, identified all the places where inventory is stored between the process and observed how the material flowed research will use stop watch to rate the time in this methodology research will use pencil, eraser and paper to draw the current state map and future, state map, and future state map.

5.1) 5'S METHODOLOGY :

5s is a Methodology has come out of the techniques within total productive maintenance (TPM) and from the Toyota production system (TPS) in 1980's. 5s is a simple tool for organizing your workplace in a clean, efficient and safe manner to enhance your productivity, visual management and to ensure the introduction of standardize working. 5s is a system to reduce waste and optimize productivity through maintaining an orderly workplace.

5s I a techniques originated from japan and it was first developed by Hiroyuki Hirano in 1980's. it include five Japanese words sieri (sort), seiton (set in order), seiso(shine), seiketsu(standardize) and shitsuke(sustain). The 5s philosophy focuses on simplification of the work environment, effective workplace organization, and reduction of waste while improving safety and quality.

" A place for everything and everything its place is the mantra of the 5s methodology "

5.2) ELEMENTS OF 5S :

In include five Japanese words seiri(sort), seiton (set in order), seiso(shine), seikestu(standardize), and shitsuke (sustain).

Table : 5s elements

Japanese word	English word	Meaning
Seiri	Sorting	Making a distinction between required and not required items and removing unneccessary items
Seiton	Set in order	Arranging the item in a system within the reach of the user.
Seiso	Shine	Clean the working place
Seikestu	Standardize	Standardize all the important process.
Shitsuke	Sustain	Make a habit to follow above 4s

6) 5S IMPLIMENTATION

6.1) SORTING :

In sorting activity, firstly we divide this activity into three categories necessary, not necessary and may not necessary. After that we removed items which is not necessary and discard the items to its specific place.

As a results, we got more space after 1S activity and that place used in the other activities. Scrap is discarded in scrap yard area. After removing unnecessary item from the shop floor we got more space.

Results of 1S is given in below table:

Table : Area Utilization .

AREA UTILIZATION AFTER 1S	
Plate yard & RM	2260 Sq. ft.
Cutting area	250 sq. ft
Gas station	400 sq. ft.
Bathing area	1032 sq. ft
Finishing area 1	804 sq. ft.
Finishing area 2	10 sq. ft.
Total	4756sq.ft.

6.2) SET IN ORDER :

After completing sorting activity we make a list of items on their number of usage times per day and from we sequencing a tools by their usage. it can helps us to reach to the materials very easily and it leads to reduce the cycle time.

Searching time

	RM Min/day	Nut & bolts Min/day	Safety equipments Min/day	Die & tools Min/ day
Before 5s	78	22	11	10
After 5s	50	7	5	5
Saved time	28	15	6	5

Materials

Fig : Searching time tools

By applying 2s activity we reduced total overall time 28 min in RM, 15 min. are in nut & bolts, 6 min. are in safety equipment and 5 min. in plate yard.

Total no of workers in finishing departments = 10

Average salary of the workers = 300 Rs/ day

= 0.625 Rs/ min

Cost saving per day = 0.625*28

= 17.5 RS

Cost saving per month = 525 RS/Month

Cost saving per year =6300 RS/Year

Total labour saving cost = 6300*10

= 63,000 Rs

Likewise a total cost saving in finishing department (10 workers)=33,750 Rs

Total cost saving for safety equipment (200)=2,70,000 Rs

Total cost saving in plate yard (10 W)= 11,250 Rs

6.3) SHINE :

Seiso is the through cleaning of the area, tools, machines and other equipment to ensure that everything is returned to a " nearly new" status. This will ensure that any non- conformity stands out; such as an oil leak from machine onto a bright, newly painted clean floor, cleaning up one's workplace daily so that there is no dust on floors, machines equipment. It will create ownership and build pride on workers

In activity of shine we give importance to clean the machines, shop floors, and other areas. We give responsibility to a particular person and clean check list for the conformation of the day by day activity.

During shine activity we also check some abnormalities like loose wire, broken parts and cracked parts.

6.4) STANDARDIZE :

We made standards very communicative, clear and easy to understand. So everyone can easy follow the standards. Checklist and labeling helps us to identify the product flow and identification machine.

6.5) SUSTAIN:

Implementation of 5s is easy but to maintain it for a long period is very hard. For sustaining the '5s' techniques effectively and strictly in the organization, internal audits as well as surprise audits are conducted periodically.

A score is calculated by audit list and from that sheet we identify the least score of the activity and try to improve it by proper management.

7) VALUE STREAM MAPPING METHODOLOGY :

7.1: STEP IN VSM

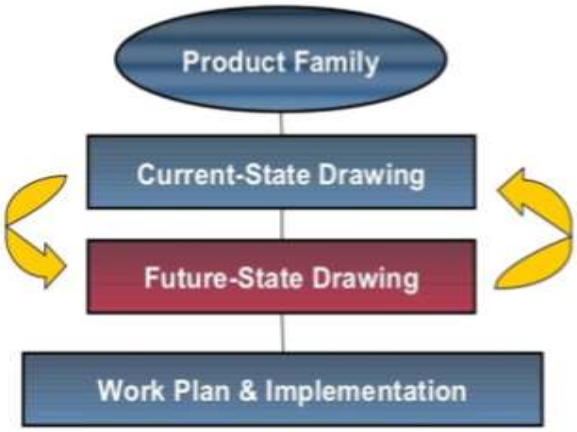


Figure 3.1 Initial steps of value stream mapping

7.2) Defining the value :

The first step in lean thinking is to determine what value is, as described by customer. Value is the information or product that the customer is willing to pay for and can only be defined by the ultimate customer. When the customer no longer accepts what they are given, producers tend to use techniques such as lowering pricing or offering a variation of the same in order to entice buyers to purchase their product.

7.3) Identifying the value stream :

A value stream needs to be indentified and it comprise all actions that are value- adding as well as non- value- adding. Identifying value streams helps to demonstrate exactly how the process operates with detailed timing of step-by-step activities. It is a systematic approach that empowers people to plan improvements that make it easier to meet customer demands.

7.4) The current state map

The current state map (CSM) charts the present flow of information and material as a product goes through the manufacturing process. This is vital both to understand the need for change and to understand where opportunities lie.

7.4.1) SELECT THE PRODUCT:

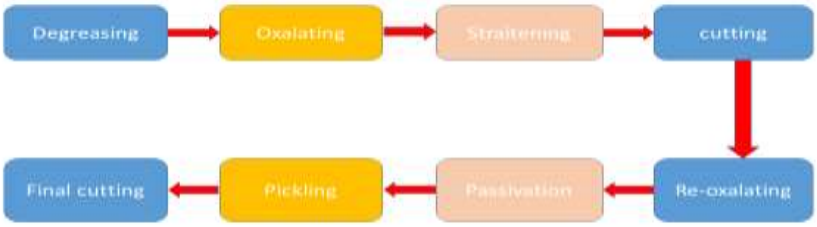
I have a select 2 value body.: **1) 19.05mm x 1mm x 6000mm.**

DATA COOLRCTION OF 19.05mm x 1mm x 6000mm

PRODUCT TYPE PIPE	19.05mm x 1mm x 6000mm
S.S material grade	Stainless steel
Outer diameter	19.05mm
Thickness	1mm
Length	6000mm

Table no 3.10.1 19.05mm x 1mm x6000mm process

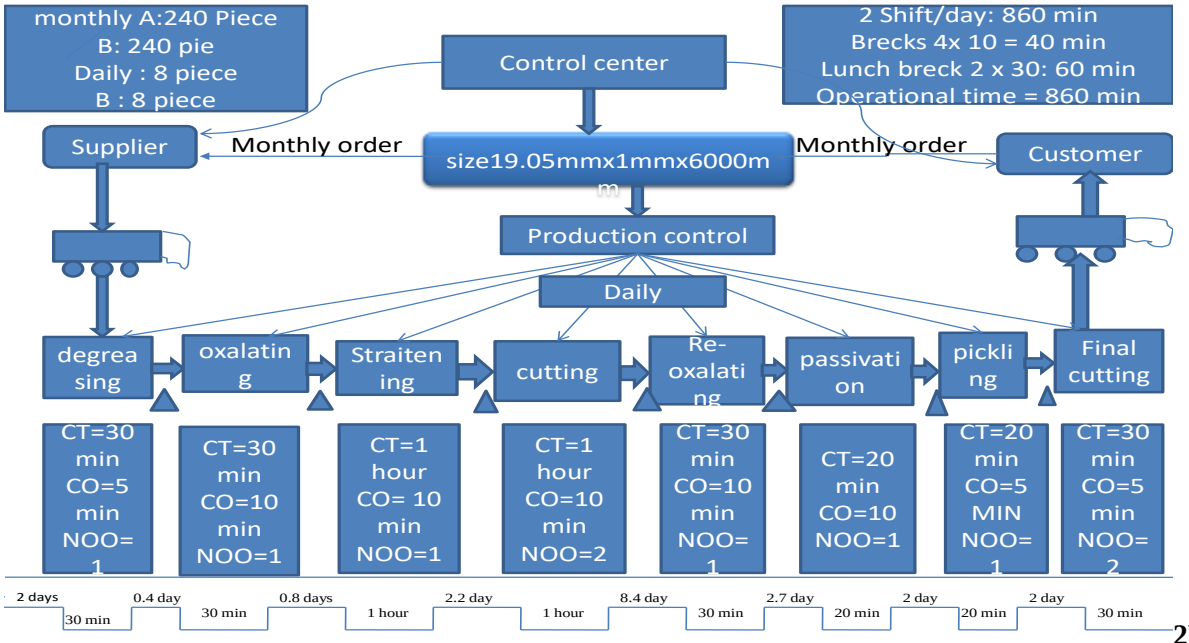
In to the 19.05mm x 1mm x 6000mm types pipe there are various process needed for the manufacturing a pipe it shown in fig. and there have different cycle time and lead time and change over time of each process it is shown in table no.



Process layout 19.05mm x 1mm x 6000mm type

❖ CURRENT STATE MAP 19.05MM X 1MM X 6000MM

❖ Before Finishing process in deep For size : 19.05mm x 1mm x 6000mm Current state map



2)

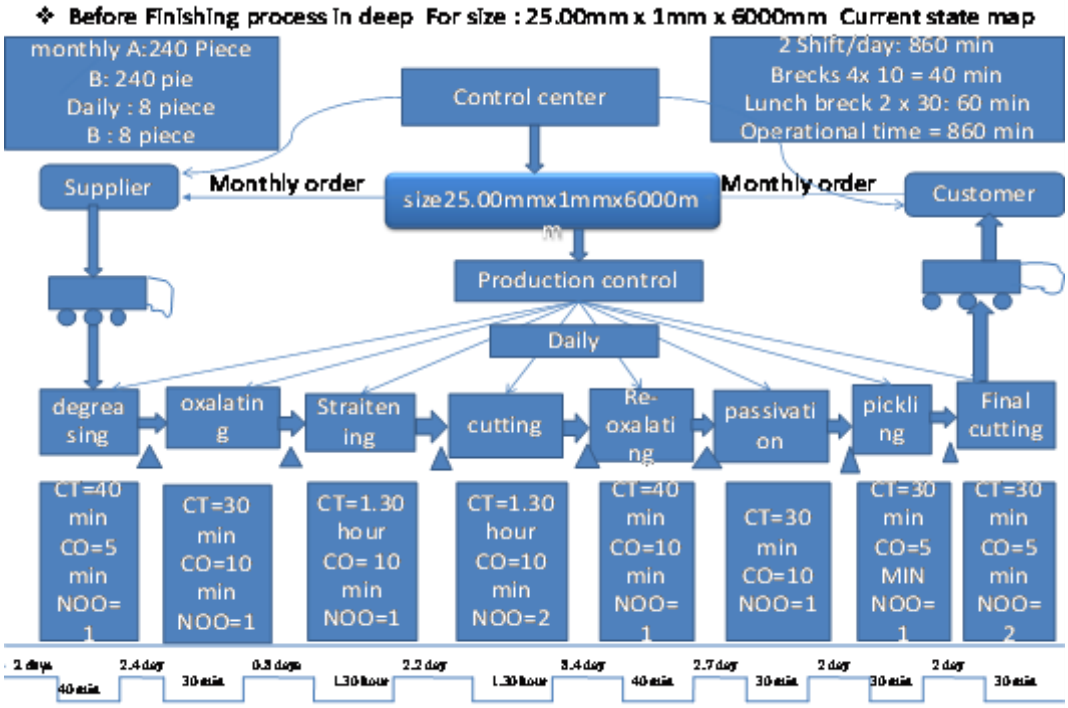
2) 25.00mm x 1mm x 6000mm

DATA COLLECTION OF 25.00MM X 1MM X 6000MM :

PRODUCT TYPE PIPE	25.00MM X 1MM X 6000MM
S.S material grade	Stainless steel
Outer diameter	25.00mm
Thickness	1 mm
Length	6000 mm

Table : 20.00mm x1 mm x6000 mm process

❖ **URRENT STATE MAP 25.00MM X 1MM X 6000 MM TYPE PIPE**



8.4.2) COMPARISION OF DIFFERENT TYPE PIPES

PRODUCT TYPE PIPE	19.05MM X 1MM X 6000MM	25.00MM X 1MM X 6000MM
S.S material grade	Stainless steel	Stainless steel
Outer diameter	19.05 mm	25.00 mm
Thickness	1 mm	1 mm
Length	6000 mm	6000 mm
Customer demand per month	300 piece	250 piece
Customer demand per day	10	9
Production per month	240	210
Production per day	8	7
Rejection per month	20	15
After rejection available piece	220	195
Gap after rejection	80 piece / month	55 piece / month

With the help of above table we can see that the 19.05mm x 1mm x 6000mm type pipe is highly demand and its consumes 75 % (shown in below pie chart) of total demand of pipes.

Fig : Product demand pie chart

9) SOME IMPROVEMENT CALULATION ARE AS UNDER.

AVAILABLE TIME

The total available production time in 8 hours per shift, there is 30 minute lunch, break and 10 minute tea break.

Total available time = no of shift x (total time per shift in minute – planned down time (time of breaks, meeting, etc.))

Total available time = 2 x (8 hour x (60 min / 1 hour) – 40 min)

Total available time = 2 x 440 minutes.

There fore the available production time is 880 minutes.

UP TIME

It is calculated by dividing actual operating time by available time. the actual operating time minute the time that the change cover takes.

Up time = (Actual operating time) / (Available time)

= (Available time – change over time) / (available time) x 100

= (880- 65) / 880 x 100

=0.9261

= 92.61 %

TAKT TIME

It is calculated by dividing available time per day by customer demand per day.

Takt time = (available time per day) / (customer demand per day)

= 880 / 10

= 88 minute

9.1) Reduction the setup time

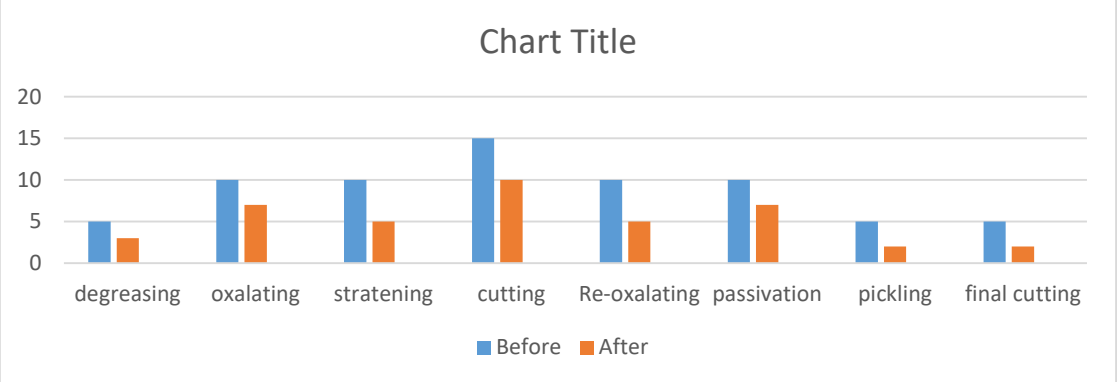
Internal setup time is tack more time from different work station machine at that time various tools are required for setup the machine.

Reduction setup time

process	Change over time Befor	After	Benefits
Degreasing	5 min	3 min	2 min
Oxalating	10 min	8 min	2 min
Straitening	10 min	5 min	5 min
Cutting	15min	10 min	5 min
Re-oxalating	10 min	5 min	5 min
Passivation	10 min	7 min	3 min
Pickling	5 min	2 min	3 min
Final cutting	5 min	2 min	3 min
Total	70 min	43 min	28 min

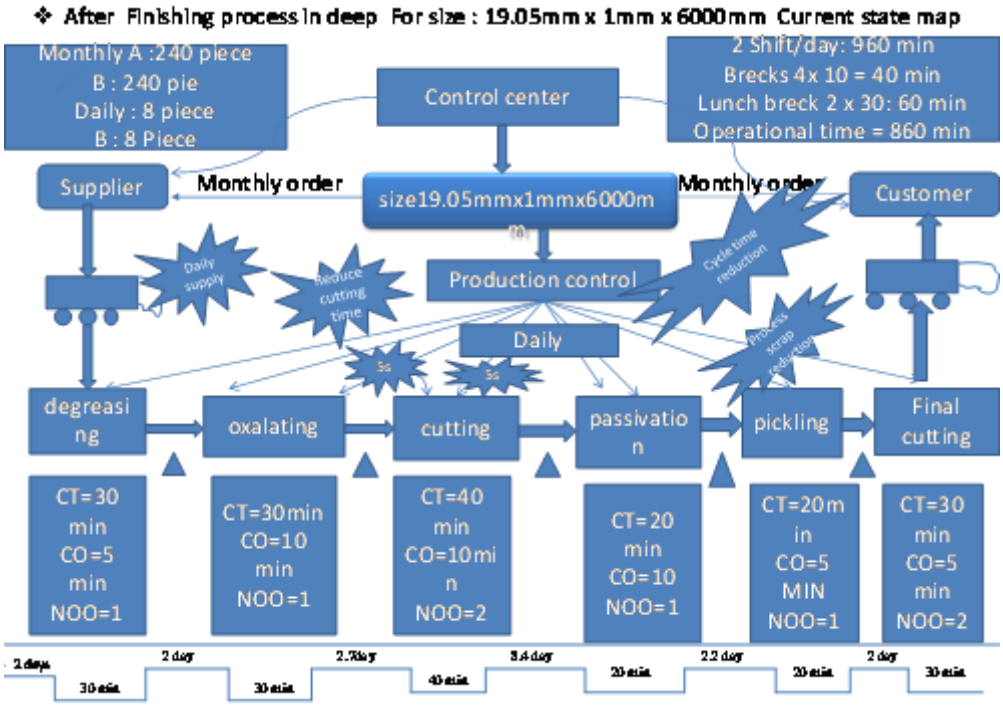
Table no 3.12.1 Change over time in all operation

9.2) REDUCTION SETUP TIME :



10) FUTURE STATE MAP OF 19.05MM X 1MM X 6000MM

Future state map of 19.05mm x 1mm x 6000mm



11) RESULT & DISCUSSION

11.1) PER PIECE REDUCTION OF PRODUCT CYCLE TIME

19.05mm x 1mm x6000 size pipe manufacture is consume 9960 sec/piece before implementing value stream mapping and after reduces the cycle time of pipe manufacture per piece is 108 sec.

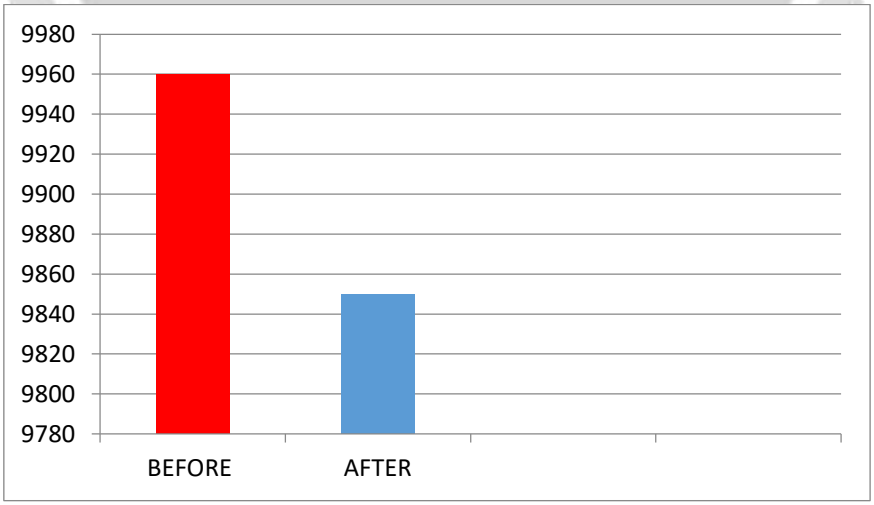


Chart of the cycle time before and after implementation of vsm

11.2) PRODUCTION BENEFITS PER MONTH

It has been observed that before implementation of vsm company make 430 pipe manufacture per month and after implementation of vsm company make 454.93 so that company has benefits of 24.93 pipe manufacture per month.

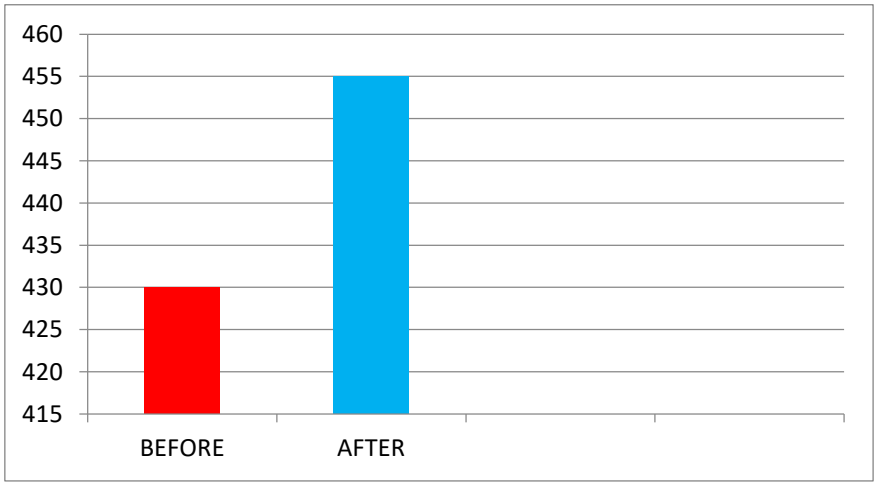


Chart of the production benefits per month

11.3) COST BENEFIT ANALYSIS

TYPE OF COST	Rs.
Shipping, handling and transportation of one pipe	120 Rs.
Staffing cost	➢ 500 Rs/ day per worker ➢ No of worker 10 ➢ 15,000 Rs per person per month ➢ 1,50,000 total staffing cost per month
Office rent	30,000/ month
Electricity	20,000/ month
Water	2000/ month
One time cost	4,00,000 Rs
Machinery cost	35,00,000 Rs

Types of cost of 19.05mm x1mm x6000 size pipe

12) CONCUSION AND FUTURE SCOPE

The research is set out to attain the benefits of value stream mapping and 5'S by applying it to the one of the product line of a steam line pvt. Ltd. The highest customer demand product line is chosen and its analysis is carried out by applying VSM methodology and calculations. from the analysis of current state map the key area are of found where improvement is required. By applying super market in two places of product line considerable benefits are achieved. The benefits are that we reduce the change over time by 3450 sec per day. And also reduce the cycle time by applying the lean tool kaizen in two places of product line, with the help of cost benefits analysis we derived that after implementation of lean manufacturing company make more 24.93 pipe per month, so that company make 454.93 pcs per month, the cost of one pipe of 19.05mm x 1 mm x 6000 size pipe is 800 Rs. So company earn more (800x24.93=19.944) Rs per month.Hence, after applying value stream mapping step along with lean tool it is concluded that value stream Mapping is a powerful lean tool for the identify waste and shows the performance of process and improvethe production without any investment.

FUTURE SCOPE :

There is a scope for extending this study by applying various lean tools such as VSM and 5's better improvement .This study was conducted in pipe manufacturing company but this improvement strategy also be implemented in other industries

13) REFERENCES:

1) ADAM BROWN ET EL " Sustainable value stream mapping (sus-vsm) in different manufacturing system configuration: Application case studies" journal of cleaner production. Vol. 85/2014,164-179.

2) ANDREW ANDERSON ET EL, " Implementation Lean Manufacturing in Amphenol TCS GBX Backplane Production Line."

3) BENJAMIN HAEFINER ET EL, " Quality value stream mapping " Variety management in manufacturing , proceeding of the 47 CIRP conference on manufacturing system, vol. 17/2014, 254-259.

4) BHIM SINGH ET EL, " Lean Implementation and its benefits to production Industry" International journal of six sigma , vol. 2/2010, 157-158.

2) DEIF," Assessing lean systems using variability mapping," 45 CIRP conference on manufacturing system 2012, vol. 3/2012, 2-7.

5) DANIJELA GRACANIN, " Using Cost- Time profit for value stream Optimization," 24 Daaam International symposium on intelligent Manufacturing And Automation, vol. 69/2014, 1225-1231.

14) EMILIANI, STEC, " Using Value Stream Maps to Improve Leadership," The Leadership and Organization Development Journal, Emeeald, Vol.25,2004,622-645.

6) FAWAZ A ET EL, " Analyzing the benefits of lean Manufacturing and Value Stream Mapping Via Simulation: A Process Sector Case Study" Int. Production Economics / 2007, vol. 107, 223-236.

7) K. VENKATRAMAN ET EL, " Application of Value Stream Mapping for Reduction of the Cycle Time in a Machining Process" 3 International Conference on Materials Processing And Characterisation, vol. 6/2014, 1187-1196.

11) P.KUIKHANG ET EL, " Methodology Approach to Increase Productivity and Reduce Lead Time in Assembly and production – Logistic processes "CIRP Journal of Manufacturing Science and Technology , Elsevier, 2011,22-32

15) P.S. SENTHILKUMAR, ET EL, " Optimization of Lean New Product Development Process Using Advanced Dual Stage Performance Phase Method", International Journal of Recent Trends in Engineering, Vol. 1, 2009,71-76

9) RAHANI AR, ET EL, " Production Flow Analysis Through Value Stream Mapping : A Lean Manufacturing Process Case Study" , International Symposium Onrobotics and Intelligent Vol. 41/2012, 1727-1734.

13) ROTHER M. & SHOOK J, " Value Stream Mapping to Add Value and Eliminate Muda, Lean Enterprise Institute", 1999.

8) WILLIAM M. GORIWONDA ET EL, " Use of the Value Stream Mapping Tool for Waste Reduction in Manufacturing." Case Study for Bread Manufacturing in Zimbabwe. Vol.22-24, 236-241.

10) ZAHIRABBAS N. KHASWALA ET EL, " Value Network Mapping (VNM): Visualization and Analysis of Multiple Flows in Value Stream Maps ", Proceeding Of The Lean Management Solution Conference, St. Louis, Ohio State University, Sep-2001.